

33. A filtering face mask that comprises:

- (a) a mask body that is adapted to fit over the nose and mouth of a wearer; and
- (b) an exhalation valve that is attached to the mask body, the exhalation valve

comprising:

(1) a valve seat that comprises:

- (i) a seal surface;
- (ii) an orifice that is circumscribed by the seal surface; and
- (iii) a flap-retaining surface; and

(2) a single flexible flap that has a fixed portion and a free portion and first and second opposing ends, the first end of the single flexible flap being associated with the fixed portion of the flap so as to remain at rest during an exhalation, and the second end being associated with the free portion of the flexible flap so as to be lifted away from the seal surface during an exhalation, the second end also being located below the first end when the filtering face mask is worn on a person, the flexible flap being positioned on the valve seat such that the flap is pressed towards the seal surface in an abutting relationship therewith when a fluid is not passing through the orifice; and

(3) a valve cover that is disposed over the valve seat and that comprises a surface that mechanically holds the flexible flap against the flap-retaining surface.

34. The filtering face mask of claim 33, wherein the valve seat is made from a relatively light-weight plastic that is molded into an integral one-piece body.

35. The filtering face mask of claim 34, wherein the valve seat has been made by an injection molding technique.

36. The filtering face mask of claim 33, wherein the seal surface is substantially uniformly smooth to insure that a good seal occurs between the single flexible flap and the seal surface, and wherein the flexible flap is made from a material that is capable of allowing the flap to display a bias towards the seal surface.

37. The filtering face mask of claim 33, wherein the flexible flap would normally assume a flat configuration when no forces are applied to it but has a curved profile when viewed from a side elevation.

38. The filtering face mask of claim 37, wherein the flexible flap is elastomeric and is resistant to permanent set and creep.

39. The filtering face mask of claim 37, wherein the flexible flap is made from an elastomeric rubber.

40. The filtering face mask of claim 33, wherein the flexible flap has a stress relaxation sufficient to keep the flexible flap in an abutting relationship to the seal surface under any static orientation for 24 hours at 70 °C.

41. The filtering face mask of claim 40, wherein the flexible flap provides a leak-free seal according to the standards set forth in 30 C.F.R. § 11.183-2, July 1, 1991.

42. The filtering face mask of claim 33, wherein the flexible flap is made from a crosslinked polyisoprene.

43. The filtering face mask of claim 33, wherein the flexible flap has a Shore A hardness of about 30 to 50.

44. The filtering face mask of claim 33, wherein the flexible flap has a generally uniform thickness of about 0.2 to 0.8 millimeters.

45. The filtering face mask of claim 44, wherein the flexible flap has a generally uniform thickness of about 0.3 to 0.6 millimeters.

46. The filtering face mask of claim 45, wherein the flexible flap has a generally uniform thickness of about 0.35 to 0.45 millimeters.

47. The filtering face mask of claim 33, wherein the one free portion of the flexible flap has a profile that comprises a curve when viewed from the front, which curve is cut to correspond to the general shape of the seal surface.

48. The filtering face mask of claim 47, wherein the flexible flap is greater than one centimeter wide.

49. The filtering face mask of claim 48, wherein the flexible flap is 1.2 to 3 centimeters wide and is about 1 to 4 centimeters long.

50. The filtering face mask of claim 33, wherein the fixed portion of the flexible flap is about 10 to 25 percent of the total circumferential edge of the flexible flap, with the remaining 75 to 90 percent being free to be lifted from the seal surface.

51. The filtering face mask of claim 33, wherein the valve seat includes a flange that provides a surface onto which the exhalation valve can be secured to the mask body, and wherein the flange extends 360 degrees around the valve seat where the valve seat is mounted to the mask body.

52. The filtering face mask of claim 33, wherein the flexible flap is positioned on the valve such that exhaled air is deflected downward during an exhalation when the filtering face mask is worn on a person.

53. The filtering face mask of claim 33, wherein the mask body is cup-shaped and comprises (1) at least one shaping layer for providing structure to the mask, and (2) a filtration layer, the at least one shaping layer being located outside of the filtration layer on the mask body.

54. The filtering face mask of claim 33, wherein a high percentage of the exhaled air is purged through the exhalation valve.

55. The filtering face mask of claim 33, wherein at least 60 percent of the total airflow flows through the exhalation valve under a normal exhalation test.

56. The filtering face mask of claim 55, wherein at least 73 percent of the total airflow flows through the exhalation valve under a normal exhalation test.

58. The filtering face mask of claim 33, wherein the exhalation valve is positioned on the mask body substantially opposite to a wearer's mouth, and wherein the flexible flap is mounted to the valve seat in cantilever fashion.

59. The filtering face mask of claim 39, wherein the exhalation valve also includes a valve cover, the flexible flap being held in position between the valve seat and the valve cover by mechanical clamping.

60. The filtering face mask of claim 33, wherein the shape of the orifice does not wholly correspond to the shape of the seal surface.

61. The filtering face mask of claim 33, wherein the valve cover further comprises:

- (i) an opening that is disposed directly in the path of fluid flow when the free portion of the flexible flap is lifted from the seal surface during an exhalation;
- (ii) a fluid impermeable ceiling that increases in height in the direction of the flexible flap from the first end to the second end; and
- (iii) cross members that are disposed within the opening of the valve cover.